*Asian Journal of Advanced Research and Reports*

***Volume 18, Issue 11, Page 51-73, 2024; Article no.AJARR.125187***
***ISSN: 2582-3248***

# Assessment of Vegetable Gardening and Its Contribution to Household Income in Tabora Municipality, Tanzania

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

***Article Information***

DOI: https://doi.org/10.9734/ajarr/2024/v18i11776

**Open Peer Review History:**
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/125187

***Original Research Article***

***Received: 13/08/2024***
***Accepted: 15/10/2024***
***Published: 19/10/2024***

## ABSTRACT

This study investigated the contribution of vegetable gardening to household income among vegetable growers in Tabora Municipality, Tanzania. Despite the potential of vegetable cultivation to improve livelihoods, many households remained reliant on limited income sources. This study

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***Cite as:*** *Kitundu, Samson Charles, Devotha B. Mosha, and Malongo R. S. Mlozi. 2024. "Assessment of Vegetable Gardening and Its Contribution to Household Income in Tabora Municipality, Tanzania". Asian Journal of Advanced Research and Reports 18 (11):51-73. https://doi.org/10.9734/ajarr/2024/v18i11776.*

aimed to ascertain the contribution of vegetable gardening to the household income in Tabora Municipality, Tanzania. Specifically, the study identified the major vegetables grown in the area and examined the relative contribution of income from vegetable sales compared to other income sources. This study employed a cross sectional study design with a mixed method approach during data collection whereas both qualitative and quantitative data were collected. A structured questionnaire was administered to 120 respondents purposively selected from three wards: Ndevelwa, Mlisha, and Kabila. Qualitative data were gathered through focus group discussions and key informant interviews. The findings revealed that a significant majority – 55.3%, 55.5%, and 80.5% – of vegetable growers acknowledged the critical contribution of vegetable gardening to their household income across three consecutive cropping seasons (2021/2022, 2022/2023, and 2023/2024). Notably, the income generated from vegetable gardening surpassed that from any other household income-generating activities. However, the study also highlighted substantial constraints: most respondents operated on small plots of land (<0.6 acres) and frequently failed to implement recommended agronomic practices effectively. These factors limited the overall productivity and profitability of vegetable production. To enhance yields and improve household income, it is essential for vegetable growers to expand their gardening plots. Furthermore, it is recommended that the Tanzanian government, through regional or local authorities, provide targeted capacity-building training on best agronomic practices and their associated benefits.

*Keywords: Vegetable gardening; household income; Tabora municipality; agronomic practices; livelihood improvement.*

## 1. INTRODUCTION

Globally, vegetable gardening is recognized as a significant practice involving the cultivation of a diverse range of horticultural crops, primarily leafy greens, root vegetables, and fruits, in various controlled environments such as backyard gardens, raised beds, or containers [1,2]. This practice is crucial for ensuring food and nutrition security worldwide [3]. Literature reviews indicate that vegetable gardening represents one of the earliest and most widespread food production systems across the globe [4]. Empirical studies have underscored the role of vegetable production in addressing food insecurity and malnutrition in developing countries, highlighting its importance as a key component of farm diversification strategies [5,6]. Furthermore, the economic benefits of vegetable gardening extend beyond mere food and nutritional security, especially for resource-poor families. Research indicates that the production of vegetables—such as tomatoes, onions, eggplants, okra, spinach, cabbage, carrots, green beans, radishes, coriander, mint, green chillies, and amaranth leaves—not only enhances income and food security for farmers but also supports input suppliers, traders, and various actors within the value chain [7].

In Australia, vegetable production was a significant contributor to agricultural income in 2020-2021, contributing AUD 4.04 billion equivalent to $2.95 billion [8]. In Africa, for centuries, vegetable gardening has been an integral component of family farming and local food systems [3]. It is an ancient and widespread practice all over African countries. In Nigeria, for example, it has been a longstanding practice, providing income and employment opportunities, particularly in dry cropping season [9]. Drawing on the study carried out in Nigeria, vegetable farming emerges as a longstanding and economically significant practice, offering income and employment opportunities, particularly during dry cropping seasons [10]. The respondents from the said study reported an average monthly income of N28,745.43 (USD 69.94), with vegetable production contributing over 80% to their overall income. Likewise, vegetable gardening is widely used as a remedy to alleviate hunger and malnutrition in the face of a global food crisis in most parts of Kenya, Rwanda, Tanzania and Ghana due to the fact that outcomes from vegetable gardening are mankind's most affordable source of vitamins and minerals requirement for good health, also provides high returns on land labour, thus creating employment opportunities and income for rural households. According to Amao [11], vegetable production serves a significant and varied role in the diets of impoverished people in Sub-Saharan Africa.

The realization of the potential of vegetable production to meet up with the necessities of life has made farmers embark on its production, not just for immediate consumption,

but also for economic benefits and poverty alleviation [6]. Studies show that many households engaged in vegetable gardening have higher incomes in contrast to those who solely rely on cereal crop production [12]. Under favorable climatic conditions vegetable production can play a significant role in the food, economy, social issues, and the environment [13,14]. However, Bittman [5] emphasizes that to tap these economic benefits of vegetable gardening, the growers, governments and development partners should give vegetable gardening greater priority probably rather than other crop production.

In Tanzania, vegetable gardening is an important sub-sector of agriculture, contributing to the country's food security and economic growth In most cases, farmers are using a combination of traditional and modern techniques including the use of irrigation systems and improved seeds [15]. Tomatoes, onions, green peppers, carrots, cabbage, eggplant and okra are the most important vegetables grown in Tanzania. Evidence shows that vegetables provide food for domestic consumption and also improve people's living standards by generating income for farmers [16]. The study conducted by Mwatawala et al. [17], on an overview of Vegetable Farming in Tanzania, revealed that vegetable production contributes significantly to household income with over 60% contribution. According to Abel et al. [18], vegetables' value chain encompasses various stages including production, marketing and consumption. Each stage within the value chain offers income-generating opportunities for different actors such as input suppliers, farmers, transporters, traders and retailers. Vegetable gardening serves as a diversified sources of income, reducing dependency on a single income stream. It also creates employment opportunities in farm activities, transportation, packaging and marketing, thus contributing to the local economy [6,19]

In Tabora region, where this study was conducted, smallholder farmers play a crucial role in vegetable production to meet local market demands and generate household income [20]. The impact of climate change has led many smallholder farmers to shift from rain-fed agriculture to irrigated vegetable production, and from subsistence towards commercialization [21]. While most of the previous studies like. Sant'Anna et al. [22] and Ebert [23] have based on prospective, ecological aspects, and the significant importance of vegetable gardening to human health and income generations, yet have neglected discussion on the extent to which gardening contributes to entire household income. Despite the widespread practice of vegetable gardening as a way of supporting nutrition and health [24], there is a lack of comprehensive research examining its precise contribution to household income. Likewise, while vegetable gardening has sprouted across the landscape of Tabora Municipal Council, the extent of its contribution to household income has been overlooked and understudied. Knowledge is also scant on the question of what are common vegetables grown in the region, the associated costs of production and how easy or difficult it is to access extension and input services, although the potential for increasing this production seems clear. The general objective of this study was to investigate the contribution of vegetable gardening to household income among vegetable growers in the study area. Specific objectiives of this study was: a) to explore the major vegetables grown in the study area; b) to analyze the income generated from vegetables compared to other sources of household income; and c) to quantify the contribution of income from vegetables to household income. This article, therefore, intends to fill some of the aforementioned research gaps, exploring the contribution of vegetable gardening to the entire annual household income compared to other income sources. The findings from this paper inform farmers and local government authorities on the economic significance of vegetable production, and action needed that might be directed to increasing or maintaining production and subsequently improving food and income as well as to enrich academic and public discussion about sustainable food systems for the future.

## 2. CONCEPTUAL FRAMEWORK

The conceptual framework of this study was derived from Chambers' livelihood theory, which analyzed how individuals and households utilized various assets and strategies to secure their well-being and income. According to this framework, the total household income comes from a variety of sources, such as vegetable farming, selling other crops, off-farm activities. Contextual factors like political, sociocultural, economic, and environmental circumstances significantly influence these income-generating activities. The framework views the overall household income as the dependent variable and

various revenue sources as independent variables. With an emphasis on the many revenue sources and the variables affecting them, this research seeks to provide a thorough grasp of how households sustain their livelihoods.

The framework makes a distinction between variables examined using quantitative and qualitative approaches in order to account for the mixed-methods approach used in the research. The study's quantitative methods center on estimating household income from a variety of sources and computing net income, which is arrived at by deducting production costs from revenues. Examining these factors' direct and indirect impacts on total family income is best done using multilevel approaches. The research qualitatively examines contextual variables, such as political pressures or socio-cultural norms, that affect how families decide how to allocate resources and develop livelihood strategies. These are more context-specific and dynamic aspects that are investigated via focus groups and interviews to provide more in-depth understanding of household motives and obstacles.

Additionally, the framework shows how these two methods merge to improve comprehension. In a step-by-step manner, the creation of quantitative survey instruments is guided by qualitative insights into contextual elements, guaranteeing that all relevant variables are included in the research. The outcomes of the two approaches are combined, and the qualitative information offers a more thorough justification for the differences in household income shown in the quantitative data. With the use of this mixed-method approach, the research is able to examine both the financial results of family activities and the larger socio-political context in which they are entrenched, producing more comprehensive findings on the sustainability of livelihoods.

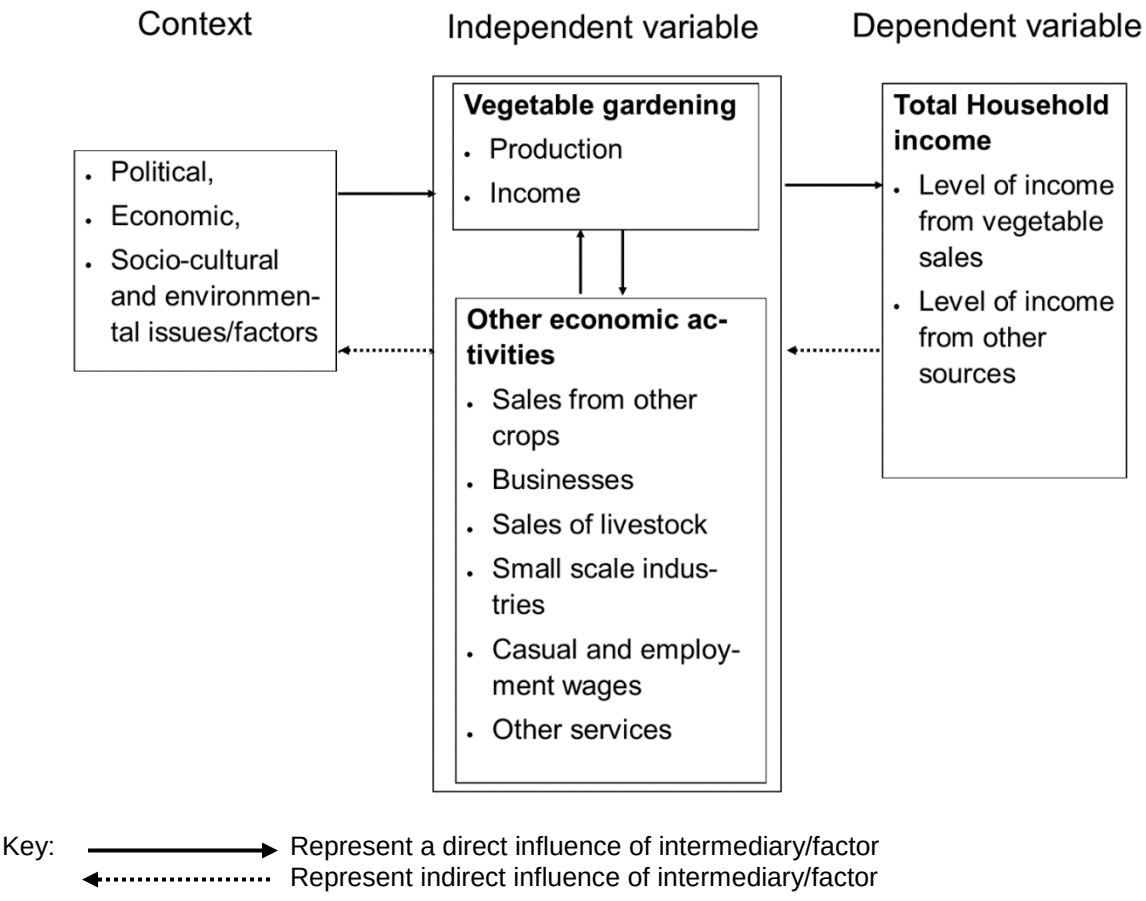


**Fig. 1. Conceptual framework of the study**

## 3. METHODOLOGY

### 3.1 Profile of the Study Area

The study was conducted in Tabora Municipal Council located in Tabora region, central-western zone of Tanzania between October 2023 and March 2024. An elevation of the Council is 1200m above sea level and lies between latitudes 4° and 7° south of the Equator and longitudes 31° to 34° east of the Greenwich Meridian. The Council was selected because many farmers in the area have shifted their livelihood strategies from depending on a rain-fed agricultural system to irrigated vegetable production systems as a result of the effects of climate change (prolonged drought and unreliable rainfall patterns). Vegetable production is a widespread practice because of its adaptability to changing climatic conditions, shorter growing periods and minimal water requirements. The selected study area generally has hot temperatures ranging from 20°C to 33°C and relative humidity from 25 to 65 % with the mean annual rainfall rangingfrom 650 to 850 mm [25]. Tabora Municipal has a total population of 308 741 (150 416 are males and 158 325 females) and theaverage household size is 4.2 people [26]. Administratively, the Council has two divisions and 29 wards. This study involved three wards namely Ndevelwa, Misha and Kabila (Fig. 2). Generally, the Council covers 109 226 hectares (ha). Out of them, 70 498.25 ha are for farming and livestock keeping, and 4 892 ha are suitable for irrigation [25]. The majority of the population is heavily reliant on agriculture, contributing 74% of the region's Gross Domestic Product (GDP), the rest (26%) include trade and small-scale industries [26]. Maize, sweet potatoes, cassava, and paddy are the main food crops, while tobacco, cotton, vegetables - eggplant, spinach, tomato, chinese cabbage, carrot, onion, okra and amaranths are common cash crops [52].

### 3.2 Research Design

The study used a cross-sectional research design which allowed primary data to be gathered at one point in time involving different methods and from different sources. The design was selected because of its efficiency in determining the relationship between variables at a time.

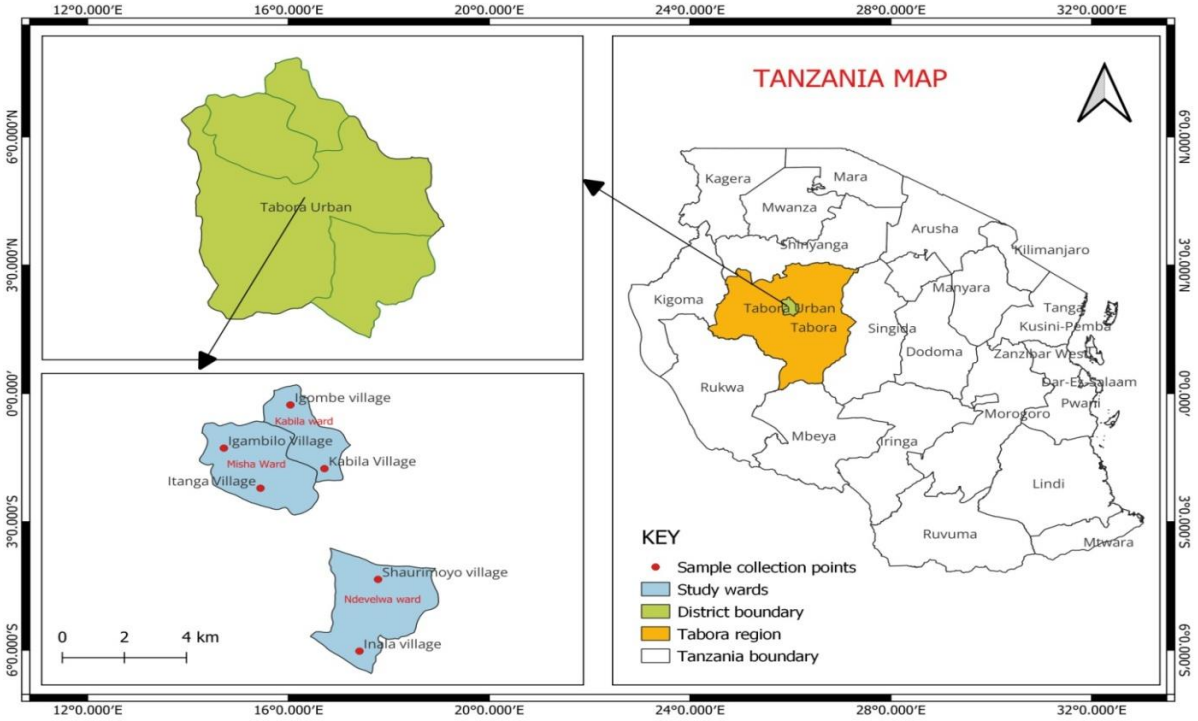


**Fig. 2. Maps of Tanzania and Tabora Region showing the location of the study area (Tabora Municipality)**

### 3.3 Sampling Procedure and Sample Size

In this study, a multistage sampling method was used. A purposive sampling method was used in the first stage for selection of divisions and wards with a high number of farmers producing vegetables to be surveyed. In the second stage, random sampling was used for selection of respondents who engage in vegetable growing and sell their products at local and central marketplace. A total of 120 survey households were obtained by selecting six villages, each of which had 20 respondents. By drawing an equal number of families from each village, this procedure guaranteed a representative sample of households actively engaged in vegetable production, minimizing bias and improving the generalizability of results across the research region.

Tabora Municipal Council comprises larger, medium and smallholder farmers, and other people whoengagein other economic activities, no government statistics show the population of vegetable growers only, whichmeans that the population for drawing sample size was not known. Therefore, the sample size for the vegetable growers was computed using the Kothari formula as recommended by Hasan and Kumar [27] as appropriate for the sample size determination of a finite population.

$$n = \frac{Z^2.p.q.N}{e^2(N-1) + Z^2.p.q}$$

Where n is the sample size, Z is the confidence level 95% score, which is 1.96, p is a sample proportion = 0.1, q = 1-p where q is equal to 0.9 and e is sampling tolerable error, which is 0.05 and N is the size of the sampling population. For this study sampling population was 900 when computing using the above formula gives the sample size (n) = 119.9945, approximation of it = 120. The population of 900 individuals was a records of vegetable growers found in Tabora Municipality

$$n = \frac{1.96\ x\ 1.96\ x\ 0.1\ x\ 0.9\ x\ 900}{0.05\ x\ 0.05(900\ -1)\ + 1.96\ x\ 1.96\ x\ 0.1\ x\ 0.9}$$

$$n = \frac{311.1696}{2.5932}$$

n= 120

Further, a distinct sampling strategy was used for the FGDs and KIIs because of the unique characteristics of the participants. Purposive sampling was used to choose 24 participants from around the villages for the focus group discussions (FGDs) who had a range of experiences in vegetable growing. These individuals were chosen on the basis of their involvement in vegetable gardening and their readiness to provide in-depth knowledge on techniques, difficulties, and social dynamics in the community. Similarly, purposive sampling was used to choose the key informants, a group of 12 people, based on their jobs and areas of expertise. Respondents included Ward Agriculture Extension Officers (WAEOs), representatives from the Municipal Agriculture, Livestock, and Fisheries Officer (MALFO), and seasoned farmers who could provide knowledgeable opinions on agricultural methods and regulations.

### 3.4 Data Collection Methods

The study adopted a mixed method approach for data collection whereby quantitative and qualitative data were collected. Since mixed method approach combines the best features of both quantitative and qualitative research methodologies, it allows for richer, more verified results and offers a more thorough knowledge of a study problem. In this study, the quantitative data were collected using household questionnaire which was constructed and designed purposely to gather important information that answers research questions. The questions asked about demographic and socio-economic characteristics of the households including income sources, experiences in farming, assets, type of vegetable and other crop production, amount harvested, earning from sales of vegetables, and earning from other major sources of income such as sales of crops other than vegetables.

Qualitative data were gathered using a checklist of questions using in-depth key informant interviews (KIIs) and focus group discussions (FGDs) approaches. A total of 24 vegetable growers were involved in FGD. Each FGD involved 12 respondents. This makes a total of two FGDs with 12 individuals in Itagavillage and 12 individuals in Inala village. The FGD comprises 6 youth, and 18 elders, with 11 women and 13 men. Further, the KII comprised four extension officers, two wards' leaders, two village leaders, two traders, and two buyers at the market. The qualitative data collected include Agricultural practices, socioeconomic factors, and access to agricultural extension services. In

addition, adequate consultation was done on publication materials which included books, journal papers, organizational reports, and academic dissertations to identify and bridge the research gaps based on the study's objective. The net income from vegetable and other crop production was computed by subtracting production costs incurred in production from the total income generated from vegetable production.

### 3.5 Data Processing and Analysis

In this study, quantitative data were coded, entered, cleaned, and analyzed using Statistical Package for Social Sciences (SPSS). Descriptive statistics and cross-tabulation were conducted to generate tables and percentages, allowing for the examination of relationships and associations between variables. SPSS has a Quantitative Analysis Technique in Means Comparison (QATMC) where a comparison of means for different groups was performed. In QATMC, vegetable production, other crop production and non-farm activities were treated as groups and were assigned discrete values and incomes from the groups were assigned continuous variables. In using QATMC, average incomes for vegetable production, other crop production and non-farm activities at the growing seasons 2021/2022, 2022/2023 and 2023/2024 were computed. For the purpose of assessing the contribution of vegetables to household income, results from QATMC in SPSS were then summarized in tables and charts using Excel.

Thematic analysis was used to analyze qualitative data because it offers a thoroughly qualitative and complete explanation of the data [28]. For this study, qualitative data from in-depth interviews and focus group discussions were read for familiarization, coded, organized into themes, reviewed, defined, named, and then written up. Content analysis was also employed to analyze the data. In order to provide a thorough picture of family income sources and the significance of vegetable production in livelihoods, the integration of both quantitative and qualitative data was crucial in this research.

To ensure the reliability and validity of the results, data triangulation was used. The research cross-verified its findings by using a variety of techniques (such as surveys, and focus groups) and key informants (agricultural officers, and extension workers), which decreased possible biases and boosted trust in the conclusions made. The qualitative accounts corroborated and strengthened the quantitative findings. By offering a comprehensive view of how contextual variables influence livelihood options and how vegetable production affects family income, the triangulated method improved the study's overall validity.

## 4. RESULTS AND DISCUSSION

### 4.1 Socio-economic Characteristics of Vegetable Growers

#### 4.1.1 Demographic characteristics

The demographic analysis of vegetable growers in Tabora Municipality revealed that a significant majority, 64.2%, were male, while 35.8% were female (Table 1). This disparity indicates a higher male participation in vegetable gardening, aligning with the findings of Regasa et al. [29], which suggested that men tend to be more engaged in vegetable production and related value chains than their female counterparts. This may be explained by the cultural and socioeconomic norms prevalent in the area, where women are more likely to take on caregiving responsibilities or perform less physically demanding jobs, whereas males are more likely to do the more labor-intensive duties associated with agriculture. The low female participation rate may also be related to women's time and ability being diverted from producing vegetables to other income-generating activities or household duties. The age distribution among respondents indicated that 40.83% fell within the 36–45 age group, followed by 22.5% aged 26–35, and 21.7% in the 46–55 age range. The observation that most of farmer had age between 36-40 may be explained as during this age, farmers are at the age of their physical and financial potential and thereby engage more in productive ventures. Compared to younger or older farmers who may not have the financial stability to engage in farming, these farmers are likely to have more farming experience and are more open to implementing new agricultural technology. The literature supports this observation, asserting that farmers in this age bracket are generally more responsive to agricultural practices compared to younger farmers under 30 years or older farmers above 60 years [30].

Regarding educational attainment, the majority (83.3%) of the vegetable growers possessed primary school education, whereas a smaller proportion had secondary (8.3%), college (5.8%),

or university education (2.5%). The large number of respondents with primary school education is due to the fact that, primary school education is compulsory for Tanzania, and the Givernment enact laws against those who ignore primary school education. Previous studies have highlighted the importance of education, noting that educated farmers have greater access to essential resources such as markets, technology, information, and finance [31,32,33].

Additionally, the marital status of respondents revealed that 82.5% were married, indicating that most vegetable farmers in Tabora Municipality bear familial responsibilities that motivate their engagement in vegetable production. The findings of Badstue et al. [34] emphasized that married individuals often benefit from collaborative efforts with their partners, which can enhance their success in agricultural endeavors. In terms of farming experience, nearly half (55.0%) of the respondents reported having over 10 years of experience, which underscores their familiarity and competency in vegetable production.

### 4.1.2 Distribution of respondents by land size ownership

The land size owned by respondents participating in this study exhibited significant variability across the wards, as presented in Table 2. The average land size owned by farmers across the surveyed areas was 6.4 acres. When broken down by wards, farmers in Ndevelwa owned an average of 7.0 acres, while those in Misha and Kabila reported average land sizes of 6.7 acres and 5.4 acres, respectively. Notably, 45% of respondents in both Ndevelwa and Misha wards owned between 3 and 5 acres of land, whereas approximately 37.5% of respondents in Kabila ward possessed less than 2 acres of land. Collectively, these findings indicate that a significant proportion of the respondents (40.0%) in the surveyed area owned between 3 and 5 acres of land.

**Table 1. Respondents' demographic data (N = 120)**

| Demographic data | Ward | | | | | | Overall | |
|---|---|---|---|---|---|---|---|---|
| | Ndevelwa | | Misha | | Kabila | | | |
| | N | % | N | % | N | % | N | % |
| **1. Respondent Sex** | | | | | | | | |
| Male | 24 | 60.0 | 21 | 52.5 | 32 | 80.0 | 77 | 64.2 |
| Female | 16 | 40.0 | 19 | 47.5 | 8 | 20.0 | 43 | 35.8 |
| **2. Respondent Age Groups** | | | | | | | | |
| <26 | 4 | 10.0 | 2 | 5.0 | 3 | 7.5 | 9 | 7.5 |
| 26 - 35 | 8 | 20.0 | 8 | 20.0 | 11 | 27.5 | 27 | 22.5 |
| 36 - 45 | 18 | 45.0 | 13 | 32.5 | 18 | 45.0 | 49 | 40.8 |
| 46 - 55 | 8 | 20.0 | 13 | 32.5 | 5 | 12.5 | 26 | 21.7 |
| > 55 | 2 | 5.0 | 4 | 10.0 | 3 | 7.5 | 9 | 7.5 |
| **3. Respondent Education** | | | | | | | | |
| Primary | 31 | 77.5 | 32 | 80.0 | 37 | 92.5 | 100 | 83.3 |
| Secondary | 5 | 12.5 | 3 | 7.5 | 2 | 5.0 | 10 | 8.3 |
| College Education | 3 | 7.5 | 3 | 7.5 | 1 | 2.5 | 7 | 5.8 |
| University level | 1 | 2.5 | 2 | 5.0 | 0 | 0.0 | 3 | 2.5 |
| **4. Respondent Marital Status** | | | | | | | | |
| Married | 28 | 70.0 | 35 | 87.5 | 36 | 90.0 | 99 | 82.5 |
| Single | 3 | 7.5 | 3 | 7.5 | 2 | 5.0 | 8 | 6.7 |
| Widow | 1 | 2.5 | 2 | 5.0 | 0 | 0.0 | 3 | 2.5 |
| Divorced | 2 | 5.0 | 0 | 0.0 | 2 | 5.0 | 4 | 3.3 |
| Separated | 6 | 15.0 | 0 | 0.0 | 0 | 0.0 | 6 | 5.0 |
| **5. Experience in Farming in Years** | | | | | | | | |
| 2 - 5 | 6 | 15.0 | 6 | 15.0 | 14 | 35.0 | 26 | 21.7 |
| 6 - 10 | 15 | 37.5 | 8 | 20.0 | 5 | 12.5 | 28 | 23.3 |
| > 10 | 19 | 47.5 | 26 | 65.0 | 21 | 52.5 | 66 | 55.0 |

*Source: Field Survey 2024*

The differences in land ownership across wards could be an indication of the geographic and economic variables affecting the distribution of land in the area. Due to advantageous land regulations or access to less populous regions, farmers in Ndevelwa and Misha, where average land sizes were bigger, may be able to possess more land. This may also be a result of the wards' historical property acquisition traditions, which favor large-scale agricultural and familial land inheritance. Conversely, the smaller land areas in Kabila can indicate a denser population or a scarcity of land, forcing farmers to labor on smaller plots.

The implications of these findings are profound, emphasizing that the majority of farmers in the study area are smallholders with limited access to and ownership of land, which is a crucial production asset. This aligns with the assertions of Rai et al. [35], who noted that land is a fundamental resource for vegetable production. Owning land is vital for farmers, as it significantly reduces production costs and enhances the feasibility of agricultural activities. Furthermore, the study by Ntihinyurwa et al. [36] highlights the correlation between farm size and agricultural productivity, indicating that smaller and fragmented landholdings can limit the potential for increased agricultural output.

Smallholder farmers are often constrained by their land size, impacting their ability to invest in better farming practices, technology, and crop diversification. As illustrated in the study, smaller landholdings may hinder farmers' potential to maximize productivity, leading to lower incomes and increased vulnerability to market fluctuations and environmental changes. Given that land ownership is closely linked to food security and rural livelihoods, it is crucial to explore interventions that can enhance access to land and promote efficient land use practices among smallholder farmers in the region.

## 4.2 Area Allocated for Vegetable Production Ward-wide

Results depicted in Fig. 3 illustrate the trend in land allocated for vegetable production over three consecutive growing seasons, specifically from 2021/2022 to 2023/2024. The overall area dedicated to vegetable production in the study area exhibited a modest increase, rising from 0.44 acres to 0.48 acres during this period. A growing consumer demand for vegetables, advantageous market circumstances, or easier access to agricultural inputs might all be contributing causes to this trend. Farmers in the study area may be progressively increasing their commitment to vegetable farming, as seen by the tiny overall increase in acreage allotted for vegetable production over the course of the three growing seasons. Notably, in Kabila ward, where 37.5% of farmers owned less than 2 acres of land, the area allocated for vegetable production declined from 0.57 acres to 0.50 acres. This decrease is concerning, as it indicates a reduction in the intensity of land use for vegetable production despite the smallholder farmers' potential to expand their plots.

In contrast, Misha and Ndevelwa wards experienced fluctuations in the sizes of land allocated for vegetable production, which suggests variability in farming practices, crop choices, or environmental conditions. External causes like poor weather, changes in market demand, or competition from other crops that are seen to be more lucrative or need less work might also be to blame for this decrease. The mixed trends observed across the wards imply that while some farmers are adopting more efficient land-use practices, others may be facing challenges that hinder their ability to allocate adequate land for vegetable cultivation.

**Table 2. Respondent's farm size in acres from vegetable producing Wards in Tabora MC (N= 120)**

| | Ndevelwa | | Misha | | Kabila | | Total | |
|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | N | % |
| ≤ 2 | 4 | 10.0 | 7 | 17.5 | 15 | 37.5 | 26 | 21.7 |
| 3 – 5 | 18 | 45.0 | 18 | 45.0 | 12 | 30.0 | 48 | 40.0 |
| 6 – 10 | 15 | 37.5 | 10 | 25.0 | 9 | 22.5 | 34 | 28.3 |
| 11 – 15 | 1 | 2.5 | 2 | 5.0 | 2 | 5.0 | 5 | 4.2 |
| > 15 | 2 | 5.0 | 3 | 7.5 | 2 | 5.0 | 7 | 5.8 |
| Average land size in acres | 7.0 | | 6.7 | | 5.4 | | 6.4 | |

*Source: Field Survey 2024*

The overall findings underscore a limited proportion of land being allocated for vegetable production, highlighting the necessity for strategies aimed at increasing land use efficiency. Expanding land area for vegetable production is critical for achieving economies of scale, as noted by Jayne et al. [37], who argued that plot expansion can lead to increased agricultural economies of scale, thereby enabling smallholder farmers to enhance their profitability while simultaneously reducing production costs.

Furthermore, encouraging smallholder farmers to adopt more intensive farming practices and explore intercropping or rotation methods could optimize land utilization and improve yield outcomes. These strategies could not only help to increase the overall area dedicated to vegetable production but also contribute to the sustainability of agricultural practices in the region, ultimately enhancing food security and rural livelihoods.

### 4.3 Major Vegetable Types

The primary vegetables cultivated in the study area included tomatoes, cabbage, green peppers, green tomatoes, Chinese vegetables, and cucumbers. Findings presented in Fig. 4 reveal that the area allocated for tomato production significantly surpassed that of other crops during the 2023/2024 growing season. The significant expansion of agricultural acreage devoted to tomato cultivation in the 2023–2024 growing season indicates the crop's rising significance as a staple crop for local farmers. There are a number of reasons for this tendency, one of which is the strong demand for tomatoes on the market. Tomatoes are a staple of many regional recipes and diets. Notably, the land allocated for tomatoes increased compared to the previous two growing seasons (2021/2022 and 2022/2023), underscoring its growing importance in local agriculture. Farmers may be encouraged to dedicate additional acreage for tomato production due to the possibility of greater revenue from tomato cultivation when compared to other crops.

In contrast, the area dedicated to Chinese vegetables, amaranth, and green pepper production fluctuated with a larger area in the 2022/2023 season than in both 2023/2024 and 2021/2022. Additionally, cabbage production saw the largest allocation of land in the 2021/2022 season, with subsequent years showing reduced areas. The land dedicated to green pepper production also fluctuated, being more extensive in 2022/2023 compared to the other two seasons. The decreasing amount of land devoted to green peppers, amaranth, and Chinese vegetables in the 2023–2024 growing season points to a change in farmer priorities, maybe brought about by shifting customer tastes or market dynamics. Farmers may have overestimated the viability of these crops due to their early success in the 2022–2023 season, which caused them to recalibrate in the following years. Farmers must adjust to market signals and consumer preferences, as seen by the finding that the 2021–2022 season had the biggest land allocation for cabbage production, which declined in subsequent years. This variation could be the result of difficulties in preserving crop quality or the competitiveness of cabbage in relation to more profitable choices such as tomatoes.

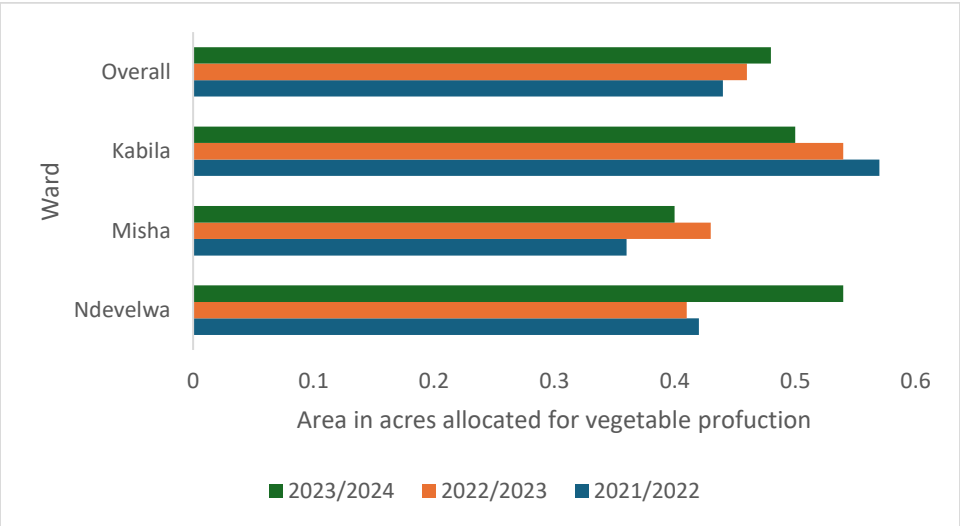


**Fig. 3. Area allocated for vegetable production across the three wards**


**Fig. 4. Areas allocated for cultivation of major vegetable**

The observed changes in land distribution for various vegetables over the three years indicate that farmers have made strategic cultivation choices influenced by crop performance, profitability, and market demands. The preference for tomato cultivation over other vegetable crops highlights shifting agricultural priorities and trends. During focus group discussions (FGDs) conducted across various villages, farmers reported a steady increase in the area under tomato cultivation. This trend is attributed to the crop's rising market value and the adoption of irrigation practices for horticultural crops as a climate change adaptation strategy.

This finding aligns with the study by Benabderrazik et al. [38], which documented a surge in tomato production in Tanzania, driven by high market prices in urban areas. On the other hand, the varying allocations for cucumbers, green peppers, and Chinese cabbage suggest a dynamic farming environment, where farmers adjust their crop selections annually based on market trends and environmental conditions. Such patterns emphasize the importance of monitoring environmental variables and market dynamics to understand and anticipate shifts in crop production strategies effectively.

The implications of these findings are significant for local agricultural policy and support systems. Therefore, by understanding which crops are prioritized and why, stakeholders can tailor their interventions–such as providing access to irrigation, improving market linkages, and offering technical support for crop management–to better align with farmers' needs and the evolving agricultural landscape.

## 4.4 Vegetable Production

Fig. 5 illustrates the total production of six major vegetables cultivated in the study area over three growing seasons. The overall production of vegetables showed a notable increase in the 2023/2024 growing season, reaching a total of 222 tons. This marks a substantial rise compared to 166 tons produced in 2022/2023 and 148 tons in 2021/2022. Specifically, the total production from the surveyed area over the three years was recorded as follows: 148 tons in 2021/2022, 166 tons in 2022/2023, and 222 tons in 2023/2024, resulting in a cumulative total of 536 tons.

The notable surge in vegetable output during the 2023/2024 growing season may be attributed to two factors: the adoption of effective farming techniques by nearby farmers and the potential growth in market demand for these products. It's possible that farmers gained from better agricultural methods, access to better seeds, and superior resource management strategies since output increased from 148 tons to 222 tons in only two years. Along with this growth, vegetable production has been trending globally and regionally due to growing customer desire for fresh produce and increased understanding of the nutritional advantages of vegetables.

This upward trend in local vegetable production mirrors a broader global increase in vegetable output, which rose from 446 million tons over the past two decades to 1.128 billion tons by 2020 [39]. Similarly, in Africa, vegetable production expanded from 44.4 million tons to 85.7 million tons during the same period [39]. Despite the increase in local production, it remains relatively small when compared to national, regional, and global levels. For instance, the vegetable production in the study area for the 2021/2022 season, at 148 tons, constituted a mere 0.005% of the national vegetable production, highlighting the limited scale of operations in the region.

The findings indicate that while local production is on the rise, it still falls significantly short of the potential contributions that smallholder farmers could make to national and regional food security. Factors such as limited access to inputs, market information, and financial resources may contribute to this disparity. To capitalize on the increasing production trends, it is imperative to implement support mechanisms that enhance farmers' capacity to increase their output sustainably.

These results suggest that there is considerable room for growth in vegetable production within the study area. Strengthening extension services, improving irrigation infrastructure, and providing access to quality seeds and fertilizers could potentially enable local farmers to enhance their productivity. Moreover, building market linkages would allow farmers to secure better prices for their produce, encouraging further investment in vegetable farming. As such, while the increase in local vegetable production is promising, it must be supported by targeted interventions and policies that address the underlying challenges faced by farmers. These efforts are crucial not only for improving local agricultural productivity but also for contributing to national and global food systems.

### 4.5 Average Vegetable Production Cost in Tanzanian Shillings

The results presented in Fig. 6 depict the costs associated with vegetable production in Tanzanian shillings (TZS) for the cultivated plots, encompassing various farming operations and inputs such as cultivation, terrace management, manure, seeds, fertilizers, pesticide application, weeding, and irrigation. Analysis reveals a consistent upward trend in production costs across the growing seasons of 2021/2022, 2022/2023, and 2023/2024 for each ward involved in the study. Overall, the total production costs increased from 1.04 million TZS in the 2021/2022 growing season to 1.11 million TZS in the 2023/2024 growing season, reflecting a 6.7% increase over the three years.

A number of variables, such as inflation, growing costs for labor, fertilizer, seeds, and pesticides, may be attributed for the steady growth in expenditures. The noted rise in production costs emphasizes how farmers who cultivate vegetables must increasingly invest financially. The expenses increased from 1.04 million TZS to 1.11 million TZS, indicating that farmers are spending more on operations and necessary supplies to sustain or improve production. The economics of vegetable growing may be greatly impacted by rising production costs, thus it is essential for farmers and policymakers to understand these dynamics. Farmers may find it difficult to maintain their businesses if they are unable to transfer these expenses onto customers in the form of increased pricing.

Furthermore, the data indicate a direct proportionality between plot size and production costs. Specifically, a 1% increase in plot size is associated with a 0.74% increase in production costs, alongside a 9% rise in income. This relationship underscores the economic dynamics of land utilization in vegetable farming, where larger plots may facilitate greater production but also incur higher operational costs.

Qualitative findings from farmers' interviews further highlight the rising costs of vegetable production, with significant concern regarding the escalating expenses associated with pesticide applications to combat diseases and pests in vegetable gardens. Key informants noted that more than 80% of vegetable growers continue to rely on traditional technologies, which exacerbates their vulnerability to rising costs associated with climate change impacts and insufficient technological investment.

These findings corroborate the results of previous studies, such as those by Lu et al. [40], which identified that increases in production costs are closely linked to fluctuations in input prices, labor costs, land prices, energy expenses, and transportation costs. The combination of these factors illustrates the multifaceted challenges that smallholder farmers face in maintaining profitability while striving to enhance production efficiency. As such, the upward trajectory of vegetable production costs in the study area necessitates urgent attention to

mitigate their impact on farmers' livelihoods. Strategies to reduce production costs, such as promoting access to affordable inputs, encouraging the adoption of modern agricultural technologies, and improving market access, will be vital for enhancing the sustainability and profitability of vegetable farming in Tanzania.

### 4.6 Income from Vegetable Production

Fig. 7 shows the average income generated from the production of different vegetables during 2021/2022, 2022/2023, and 2023/2024 growing seasons. The income generated from tomato production was far higher than the income generated from other vegetables in both 2021/2022, 2022/2023, and 2023/2024. With exceptional G/Tomato and eggplant, the income generated from each specific vegetable showed an increasing trend, with higher income being generated in the 2023/2024 growing season as compared to the rest growing seasons (2021/2022, and 2022/2023) (Fig. 7).

A number of reasons, such as enhanced market accessibility, enhanced farming methods, and rising consumer demand for vegetables, contributed for the observed expanding profitability. According to the statistics, farmers seem to be benefiting from their investments and hard work in growing vegetables.The findings are in line with the findings by Mutayoba and Ngaruko [41] who emphasized that, despite the challenges facing tomato growers, significant profit can be generated from tomato farming which would attract more farmers in tomato production.

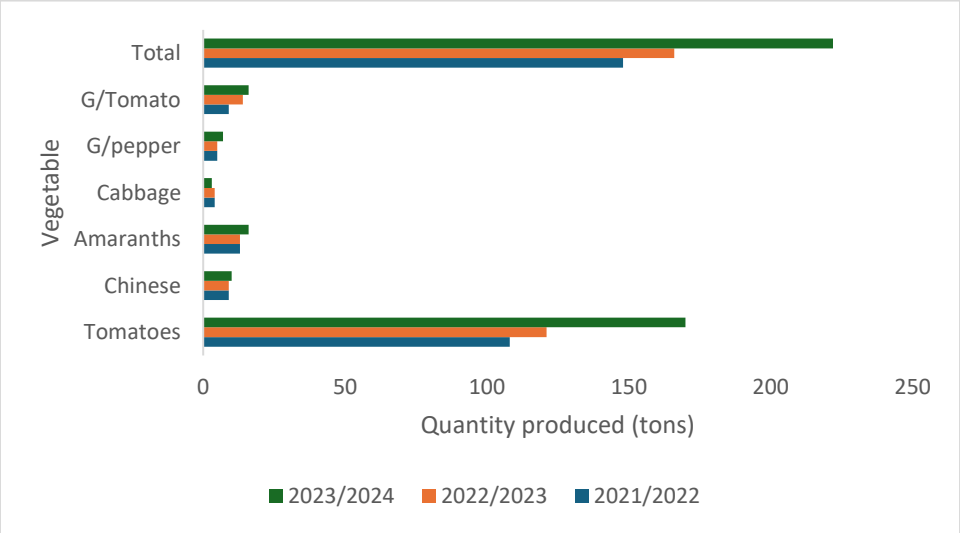


**Fig. 5. Quantity of vegetables produced (in tons)**

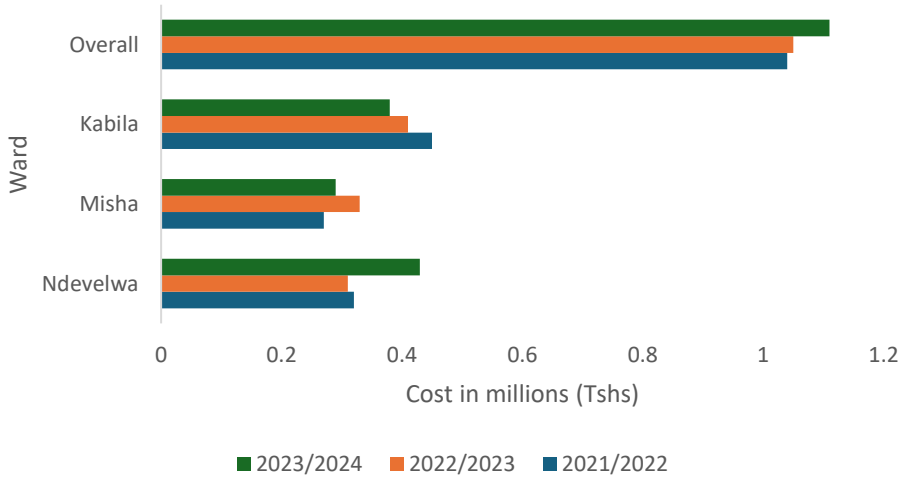


**Fig. 6. Vegetable production cost**

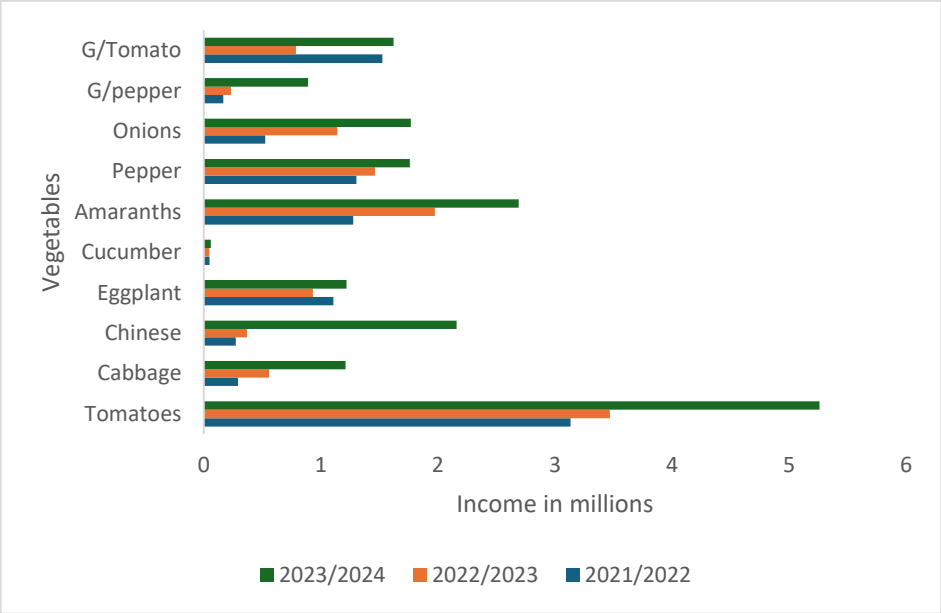


**Fig. 7. Income earned from vegetable production**

The findings from this study indicate that the overall income grew from TZS 6.64 million in 2021/2022 to TZS 12.03 million in the 2023/24 growing season per household. This is an increase inincome from vegetable production by 81.2% over the three years. While income from vegetables increased from TZS 6.64 million in 2021/2022 to TZS 12.0 million in 2023/2024 growing seasons, plot size increased (in acres) from 0.44 to 0.48 equivalent to an increase of 9.81%. These results imply that an increase in plot size by 1% yielded an increase of 9% in the income from vegetable production. This increase of income is an incentive to farmers that encourages and motivates farmers to pay more attention to vegetable production [42].

The findings from qualitative data highlight that increasing income from vegetable gardening is mostly ascribed to the availability of better inputs and enhanced farming methods. Further, instead of depending exclusively on increasing plot size, farmers often emphasized that they were able to optimize productivity on their current land through training in modern techniques and the availability of seeds and fertilizers (organic and inorganic). Agricultural extension officers confirmed that focused interventions and ongoing technical support were critical to increasing yields. The farmers' prudent but effective approach of prioritizing the optimization of their current resources to obtain higher income is reflected, despite the minor increase in plot size. Equally, Mujuru and Obi [43] highlighted that vegetable production is an important source of livelihood and household income for smallholder farmers and surrounding communities.

Further, the results in Table 3 indicate that net income rose from TZS 5.60 million in the 2021/2022 growing season to TZS 10.93 million in the 2023/2024 growing season which is an increase of income by 95%. This implies that in Tabora Municipality, a unit increase of 1% of plot size allocated for vegetable production gave an increase of 10.5% of net income from vegetable production. Farmers credited the deliberate development of their plots and the implementation of more productive agricultural techniques for this notable increase in income. One farmer stated, *"Expanding my plot by just a small margin has made a big difference in my earnings, especially now that I know how to get the most out of my land."* Someone else commented, *"With the knowledge we've gained on better farming techniques, even a slight increase in land area results in a much higher income."*

Further, extension officers who participated in key informant interviews provided additional evidence for this observation, saying that *"farmers who have slightly expanded their plots and improved their farming methods have seen their net incomes rise dramatically, reflecting the high returns on even small increases in land dedicated to vegetable production."* These qualitative insights demonstrate how the region's net earnings have increased dramatically as a result of improved farming methods and plot development.

**Table 3. Income from vegetable production (in million TZS)**

| Ward | Variable | Growing seasons | | |
|---|---|---|---|---|
| | | 2021/22 | 2022/23 | 2023/24 |
| Ndevelwa | Income | 3.29 | 3.48 | 7.28 |
| | Production cost | 0.32 | 0.31 | 0.43 |
| | Net income | 2.97 | 3.17 | 6.85 |
| Misha | Income | 1.8 | 1.84 | 2.97 |
| | Production cost | 0.27 | 0.33 | 0.29 |
| | Net income | 1.53 | 1.51 | 2.68 |
| Kabila | Income | 1.55 | 2.1 | 1.78 |
| | Production cost | 0.45 | 0.41 | 0.38 |
| | Net income | 1.1 | 1.69 | 1.40 |
| Total | Income | 6.64 | 7.42 | 12.03 |
| | Production cost | 1.04 | 1.05 | 1.10 |
| | Net income | 5.6 | 6.37 | 10.93 |

*Source: Field Survey 2024*

The increase of net income from vegetable production by 95% creates an opportunity for more farmers to engage in vegetable production. Given that vegetable crops provide faster returns than other agricultural goods, their attractive profit margins and increased market demand are probably the main reasons for the 95% rise in net revenue from vegetable production. This notable increase in profitability may also have been attributed to enhanced market channels, improved input availability, and improved agricultural practices, which in turn attracted more local farmers to vegetable cultivation. This is in line with the study by Gebru et al. [44], who found that smallholder farmers engaged in vegetable gardening had a significant increase in income. Vegetable gardening helps to provide jobs and reduce poverty, especially for women and young people [45,46]. Further, Razanakoto et al. [47], claims that smallholder farmers can use vegetable gardening as their main business if they have easy access to resources including land, credit and inputs. The sector presents opportunities for attracting the young and educated unemployed if cultivable lands, inputs, credit and social overheads that will make the farming communities livable are provided [47].

On the contrary, Shrestha et al. [48], discovered that high input costs and restricted market access can make vegetable gardening less profitable, which may discourage young, educated jobless people from pursuing the industry. Furthermore, Njoku and Okorie [49] contended that there are substantial hazards associated with the price volatility of vegetables and their susceptibility to climate change, which may reduce the appeal of vegetable growing as a sustainable livelihood approach. Therefore, even though the income potential is high, these issues need to be resolved to take full advantage of the sector's opportunities.

## 4.7 Other Livelihood Strategies

Apart from vegetables, other livelihood strategies contribute to household income encompassing the production of other crops and non-farm activities. Crops such as groundnuts, maize, beans, cassava, and sunflower oil were observed to be grown by the interviewed farmers. Furthermore, vegetable farmers in Tabora were found to be involved in other non-farm activities such as trading, entrepreneurship and sewing. This implies that farmers have diversified sources of income which might help them during the vegetable off-season.

### 4.7.1 Other crops production

The findings in Table 4 show notable differences in land allocation, gross revenue, production cost, and net income across the three wards. In this table, there is no data for income in the 2023/2024 growing season because when the study was conducted there was no harvest yet.The land allocated for the production of crops other than vegetables was1.96 acres higher in Kabila ward followed by Misha ward (1.44 acres), and Ndevelwa ward (1.30 acres) respectively. The gross income from the production of other crops for Kabila (1.80 million) and Ndevelwa (1.79 million) was nearly similar despite the differences in land allotment, while for Misha ward (0.82 million) was substantially low. The disparities in net income, gross revenue, and land distribution among the three wards demonstrate different agricultural practices and output, which have important ramifications for resource allocation and policy formation.

Kabila ward may benefit from more diverse and maybe more effective farming practices, as evidenced by the ward's increased land allotment for non-vegetable crops and its comparatively high gross income. However, Misha ward's lower gross income despite having a considerable amount of land allocated to it suggests that there may be inefficiencies or less viable crop selections, which emphasizes the need for focused improvements in input access or agricultural practices. Further, the observed disparity in income implies that variables outside the extent of land, such as crop productivity or market values, have a noteworthy influence on the revenue generated from agriculture [50]. These results imply that, to enhance agricultural output and income generation in each ward and guarantee that every area may realize its full agricultural potential, specific interventions and resource allocation plans are required.

Furthermore, Kabila ward had the highest production cost (1.06 million) followed by Misha ward (0.86 million) and Ndevelwa ward (0.62 million) respectively. In terms of net income, Ndevelwa ward (1.17 million) outperformed Misha (-0.04 million) and Kabila (0.74 million). This suggests that the increased profitability of Ndevelwa ward was a result of its effective production cost. The overall plot size, gross income, production cost, and net income from the production of other crops were 4.70 acres, 4.41 million, 2.54 million, and 1.91 million respectively. These results emphasize the necessity of production cost control and effective resource use for generating larger net earnings.

The three wards' markedly different net income, gross revenue, and land distributions all indicate different farming techniques and degrees of resource use efficiency. The higher gross revenue of Kabila ward and the larger amount of land set up for non-vegetable crops suggest the possibility of more varied and productive agricultural methods. In contrast, Misha ward's lower gross revenue highlights the need for specific interventions to increase input availability and better agricultural methods, as it raises concerns about potential inefficiencies or less viable crop choices despite large land allocation. The observed inequalities in income show how important elements influencing agricultural revenue beyond land area include crop yield and current market pricing. Thus, to fully realize each ward's agricultural potential, specialized interventions and resource allocation plans are necessary.

The average income generated from the cultivation of crops other than vegetables during the 2021/2022 and 2022/2023 growing seasons is portrayed in Fig. 8. Higher-income was generated from tobacco production in both 2021/2022 and 2022/2023 compared to the remaining crops. Further, the income generated from each specific crop (beans, groundnuts, paddy, sunflower, sweet potatoes, tobacco, cassava, maize) showed an increasing trend, with higher income being generated in the 2022/2023 growing season as compared to 2021/2022 (Fig. 8).

**Table 4. Income from other crops production (in million TZS)**

| Ward | Variable | Growing seasons | | |
|---|---|---|---|---|
| | | 2021/22 | 2022/23 | 2023/24 |
| Ndevelwa | Plot size in acres | 1.30 | 1.35 | 1.52 |
| | Income | 1.79 | 2.49 | |
| | Production cost | 0.62 | 0.65 | 0.81 |
| | Net income | 1.17 | 1.84 | |
| Misha | Plot size in acres | 1.44 | 1.52 | 1.78 |
| | Income | 0.82 | 1.20 | |
| | Production cost | 0.86 | 0.89 | 1.08 |
| | Net income | -0.04 | 0.31 | |
| Kabila | Plot size in acres | 1.96 | 2.03 | 2.00 |
| | Income | 1.80 | 2.35 | |
| | Production cost | 1.06 | 1.09 | 1.05 |
| | Net income | 0.74 | 1.26 | |
| Total | Plot size in acres | 4.70 | 4.90 | 5.30 |
| | Income | 4.41 | 6.04 | |
| | Production cost | 2.54 | 2.63 | 2.94 |
| | Net income | 1.91 | 3.41 | |

*Source: Field survey 2024*

While revenue from other crops such as tobacco, beans, groundnuts, maize, sweet potatoes, cassava, sunflower, and paddy has generally been rising, this suggests that both agricultural production and market conditions have improved. This upward trend raises the possibility that farmers are using more productive farming techniques or are reaping the benefits of improved market accessibility and pricing. The potential for crop production diversification is shown by the higher revenue from these crops in the 2022–2023 season as compared to the previous year. This might improve food security and support the lives of local farmers. This pattern also suggests that the agriculture sector may be able to provide even more revenue and resilience to the economy by making targeted investments in agricultural inputs and farmer assistance.

### 4.7.2 Income from non-farm activities

Results in Fig. 10 show that livestock was the most preferred type of non-farm activity in the study area followed by business, salary and other sources. The average income earned from salary (formal and casual employment) was higher as compared to income from business and livestock (Fig. 9). A variety of sources of income demonstrates the adaptive measures that rural households use to improve their financial stability and reduce the risks that come with being dependent on agriculture. Additionally, the presence of business ventures and livestock raising implies that these industries are vital to the local economy, offering extra sources of income that might bolster family resilience and investments in agricultural output. The findings align with a study conducted by Kassegn and Endris [51] who reported that, while most rural households are involved in agricultural activities as their main source of livelihood, they also engage in other income-generating activities to augment their main source of income.

## 4.8 Contribution of Vegetable Production to Household Income Compared to Other Sources

Results in Table 5 show more income from vegetable production in comparison with other sources. In the 2021/2022 growing season, the overall income from vegetables was TZS 5 595740 while from other crops the income was TZS 1, 913, 100 and TZS 2,675,222 from nonfarm activities. The same trend occurred in the other two vegetable growing seasons. Results further show contribution in percent for each source, location and growing season.

Numerous variables may be contributed to this observation. First, farmers are being encouraged to devote more resources to vegetable production due to the growing demand for fresh vegetables, which is being driven by both local consumption and market potential. Vegetable farmers may profit greatly from the growing demand for fresh vegetables brought about by rising urbanization and population growth. Furthermore, farmers may achieve returns faster with many vegetables due to their shorter growing cycles than staple crops, which improves cash flow and stabilizes family income.

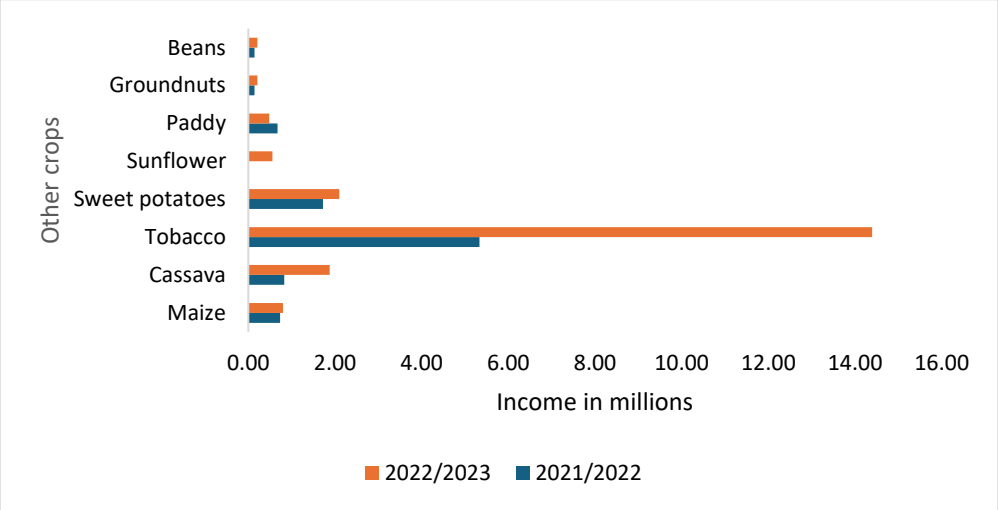


**Fig. 8. Income earned from crops other than vegetables**

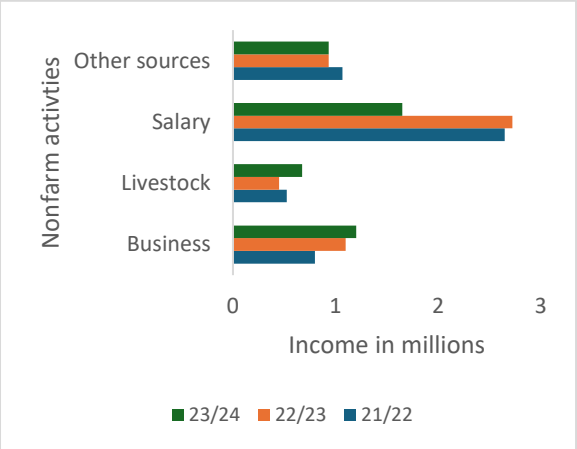


**Fig. 9. Income earned from nonfarm activities**

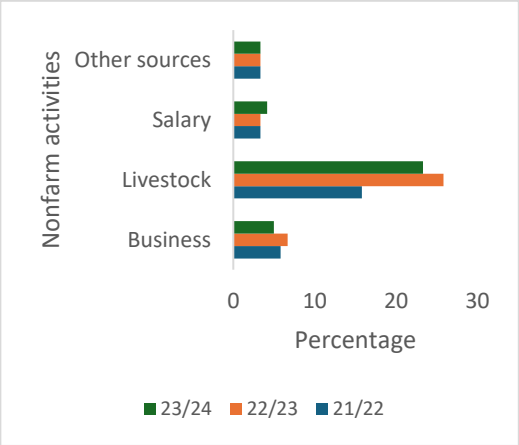


**Fig. 10. Involvement of the respondents to nonfarm activities**

Furthermore, access to improved inputs like high-quality seeds and fertilizers as well as advancements in agricultural methods may be responsible for the reported rise in revenue from vegetable production. It's possible that farmers have adapted more productive farming methods, producing better-quality food with larger yields and higher market prices [53,54]. The availability of agricultural training programs and extension services may have contributed to providing farmers with the information and abilities needed to maximize output. Additionally, by combining vegetable growing with other revenue-generating ventures, families may be able to diversify their sources of income, lessening their reliance on volatile markets and bolstering the agricultural economy.

The results indicate an increasing trend in the income generated from vegetable production within the three consecutive growing seasons. In the 2021/2022, 2022/2023 and 2023/2024 growing seasons the income from vegetables was5595740 TZS, 6 380 350 TZS and 10924100 TZS respectively. The increasing trend was also observed in income generated from crops other than vegetables. Further, the percentage contribution of vegetables to household income was higher (80.4%) during the 2023/2024 growing seasons as compared to the 2021/2022 and 2022/2023 growing seasons which had 55.5% and 53.1% contributions respectively.

The findings underscore the paramount significance of vegetable cultivation as a means of augmenting family earnings and strengthening food security within rural communities. Through leveraging current market trends and using enhanced farming methods, farmers may optimize their earnings and augment the regional economy as a whole. Vegetable production is becoming more and more important for local economies and family lives. As a result, policies and initiatives that encourage agricultural innovation and market access for vegetable producers are required.

The findings from this study align with the findings by ABARES [8] who reported that in Australia, vegetable production was a significant contributor to national Agricultural income in 2020-2021, contributing AUD 4.04 billion equivalent to $2.95 billion. Further, the findings are consistent with the study conducted in Nigeria by Mukaila et al. [10] who pointed out that vegetable production contributes over 80% of the household income. Also, this study aligns with Mwatawala et al. [17] which reported that vegetable production contributes significantly to household income with over 60% contribution followed by other crops at 20.9%, petty business at 8.6% and livestock production at 7.4%.

Further, Table 7 shows the t-test statistics which compared the mean revenue from vegetables and mean revenue from other sources at p=0.05. Mean income from vegetables (1.99±0.35 million) was significantly higher than mean income (0.91±0.26 million) from other sources ($p<0.05$). This implies that compared to other sources of revenue, vegetables in the study area provide a more considerable income, underscoring their economic significance. The observation might be due to the fact that vegetables have shorter growing seasons, more market demand, and superior profit margins [5]. These results suggest that encouraging vegetable gardening could improve family income and regional economic stability.

**Table 5. Net Income from vegetables as compared with income from other sources**

| Ward | 2021/2022 | | 2022/2023 | | 2023/2024 | |
|---|---|---|---|---|---|---|
| | **Income** | **Percent** | **Income** | **Percent** | **Income** | **Percent** |
| Ndevelwa | 2 972970 | 53.1 | 3 174 300 | 49.8 | 6 854 020 | 62.7 |
| Misha | 1 526 590 | 27.3 | 1 517 520 | 23.8 | 2 675090 | 24.5 |
| Kabila | 1 096 180 | 19.6 | 1 688 530 | 26.5 | 1 395 310 | 12.8 |
| **Total** | **5 595 740** | **100** | **6 380 350** | **100** | **10 924 420** | **100** |
| **2. Net Income from other crops** | | | | | | |
| Ndevelwa | 1 170 000 | 61.3 | 1 840 000 | 54 | | |
| Misha | 0 | 0 | 310 000 | 9 | | |
| Kabila | 740 000 | 38.7 | 1 260 000 | 37 | | |
| **Total** | **1 910000** | **100** | **3 410000** | **100** | | |
| **3. Income from non-farm activities** | | | | | | |
| Ndevelwa | 360 000 | 14.0 | 354 545 | 15.9 | 425 000 | 15.9 |
| Misha | 936364 | 36.4 | 661 111 | 29.7 | 815 385 | 30.6 |
| Kabila | 1276923 | 49.6 | 1 21 111 | 54.4 | 1 427 778 | 53.5 |
| **Total** | **2 573287** | 100.0 | **2 226 768** | 100.0 | **2 668162** | 100.0 |

*Source: Field survey 2024*

**Table 6. Overall comparison of income from vegetables with other sources of income**

| Source | 2021/2022 | | 2022/2023 | | 2023/2024 | |
|---|---|---|---|---|---|---|
| | **Mean** | **Percentage contribution** | **Mean** | **Percentage contribution** | **Mean** | **Percentage contribution** |
| Vegetable | 5 595 740 | 55.5 | 6 370 350 | 53.1 | 10 924420 | 80.4 |
| Other crops | 1 910000 | 19.0 | 3 410 000 | 28.4 | 0 | 0.0 |
| Nonfarm | 2 573 287 | 25.5 | 2 226 768 | 18.5 | 2 668 162 | 19.6 |
| **Total** | 10 079 027 | 100 | 12 007 118 | 100 | 13 592 582 | 100 |

*Source: Field survey 2024*

**Table 7. Mean comparison of income in millions from vegetables and income from other sources using t-test at p = 0.05**

| Source of income | Mean income | Std. Error | t-statistic | p value |
|---|---|---|---|---|
| Vegetables | 1.99 | 0.35 | 2.487 | 0.032 |
| Other sources | 0.91 | 0.26 | | |

Since vegetables may be harvested numerous times in a year and can react quickly to market demand, their shorter growing seasons might result in higher pricing for fresh food. Vegetables are also often more profitable for farmers to grow than other agricultural goods due to their higher profit margins. Fresh vegetables are consistently in high demand from consumers, which supports their economic feasibility. This means that encouraging vegetable gardening has the potential to greatly raise family incomes and support regional economic stability.

## 5. CONCLUSION

This study highlights the significant role of vegetable gardening in enhancing household income in Tabora Municipality, where it contributes over 50% to total household income. Despite its importance, the findings indicate that a limited proportion of land is allocated to vegetable production, resulting in suboptimal yields. This situation not only constrains potential income from vegetable gardening but also diminishes its overall contribution to household financial stability.

To enhance vegetable yields and, consequently, their impact on household income, it is crucial to increase the area dedicated to vegetable gardening. Additionally, the adoption of recommended agronomic practices will be vital in optimizing production. Expanding and improving irrigation infrastructure is imperative, as it would empower farmers to cultivate larger plots of land, thus increasing their capacity for vegetable production.

The study also revealed a predominance of tomato cultivation among farmers, with a

significant proportion of household income derived from this crop. However, despite the high level of tomato production, the observed yields are substantially lower than global averages, indicating a gap that needs addressing. This discrepancy underscores the necessity for further research into the factors affecting tomato productivity within Tabora Municipality.

In general, enhancing land allocation for vegetable gardening, adopting effective agronomic practices, and improving irrigation systems can significantly boost vegetable yields. Such improvements are essential for increasing the economic benefits of vegetable gardening and ensuring greater financial resilience for households in the region.

## 6. RECOMMENDATIONS

Based on the findings from this study, the following were the recommendations:

i. Encourage Land Allocation for Vegetable Gardening: The government should implement initiatives to motivate farmers to allocate a larger percentage of their land to vegetable gardening. By promoting the economic benefits of larger plots, the government can help increase vegetable yields, ultimately enhancing household income and financial stability.
ii. Investment in Irrigation Infrastructure: The Government of Tanzania, in collaboration with regional authorities, should prioritize the development and expansion of irrigation infrastructure in rural areas, particularly in Misha, Kabila, and Ndevelwa wards. Improved irrigation systems will enable vegetable growers to cultivate larger areas, thereby increasing productivity and mitigating the risks associated with climate variability.
iii. Promotion of Crop Diversification: While tomato cultivation is currently favoured among farmers, it is essential to encourage the cultivation of a broader range of vegetables. Diversifying crop production can enhance household income by reducing dependency on a single crop and spreading financial risk across multiple products. Additionally, the government and agricultural organizations should provide training and resources to support farmers in exploring diverse cropping options.
iv. Research on Tomato Production Challenges: Further research is warranted to identify and address the factors contributing to the suboptimal production of tomatoes in the region. This research should focus on understanding the underlying causes of low yields and should aim to develop strategies and practices that enable farmers to enhance tomato output to meet international standards.
v. Extension Services and Capacity Building: Strengthening agricultural extension services is crucial for providing farmers with access to knowledge about best practices in vegetable production. Training programs should be established to educate farmers on modern agricultural techniques, pest management, and sustainable practices that can lead to improved yields and increased profitability.
vi. Access to Financing and Resources: To facilitate the expansion of vegetable gardening, the government should explore options for providing financial assistance and access to resources for farmers. This may include grants, low-interest loans, and subsidized agricultural inputs, which will empower farmers to invest in their operations and adopt new technologies.

## DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

## CONSENT

In compliance with global or academic norms, the author(s) has gathered and maintained the written permission of the respondents.

## ACKNOWLEDGEMENT

We would like to acknowledge the vegetable small-scale farmers, Municipal agriculture, irrigation and corporative officers, Ward agricultural extension officers, Ward executive officers, village leaders, Mr. YusuphKilanga, and Dr. S.Y. Nyamba from the Department of Agricultural Extension and Community

Development for their cooperation in the accomplishment of this study.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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